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Health representations, perceived valence and concept associations for symbols as food cues: A mixed methods approach

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Abstract

Researchers have experimented with a range of point-of-purchase (PoP) interventions in supermarkets, restaurants and cafeterias. In general these interventions have employed written materials. This research tested symbols to visually summarize information about the (un)healthiness of food. Study one explored health representations and valence associated with the image of a heart, bathroom scale and a running shoe using qualitative field interviews (N=1200). Study two explored accessibility of a priori concept associations for two of those images, stratified by valence, in a computerized response latency task (N=40). Study one indicated that the heart was best linked to its intended theme 'heart health'. Concerning valence, the heart was seen as both positive and negative whereas the scale was less likely to be viewed as positive relative to the running shoe. In study two, the heart was linked to five of the six a priori concepts and there was evidence that three of these were more accessible. Overall, the heart was better linked to positive poles than negative ones. A heart symbol may be useful to prompt heart healthy choices at the PoP. There was evidence that a scale may bias choice away from undesirable foods.

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Frequent consumption of food away from home has been linked to higher rates of obesity (Pereira, Kartashov, Ebbeling, Van Horn, Slattery & Jacobs, 2005). One public health approach to this issue is to label food with its calorific content at the point-of-purchase (PoP). Although widely implemented in the United States, calorie counts may not have the intended effect of decreasing calories purchased, especially in quick service restaurants where people may not spend the time deliberating about their decision. Indeed, research on the efficacy of calorie counts at the PoP in quick service restaurants have produced weak and inconsistent results (cf. Swartz, Braxton and Viera, 2011). Simpler labeling formats may be more effective in helping consumers make healthier choices. Communicating health related information with symbols, for example, may be a more effective way to influence choice at the PoP. Consumers often use symbols on front of pack labels to help them shop quickly. Symbols act as short cuts to information because they can instantly convey meaning; they do not require extensive cognitive processing and they make the decision process more efficient (Enright, Good & Williams, 2010).

In Finland, the heart symbol has been used to indicate better choices regarding saturated fat and sodium. For some product groups, it also indicates better choices regarding sugar and fiber. In contrast in the UK, the food industry have used the heart symbol to communicate information about calories, e.g. on Zizi menus to indicate items with less than 600 calories. The Special K brand has used a bathroom scale on their products to indicate a low calorie choice. Despite widespread use of symbols to communicate health information, no studies have tested the meaning of these symbols to consumers in the context of food and health.

The exchange of information, transmission of meaning and capacity to influence are the desired goals in any health communication process. Thus effective health communication requires that both the message source and receiver understand a common language or code. Symbols, by their very nature, are open to interpretation which may confuse the intended meaning. A careful study of the correspondence between symbols as they are sent and received is thus of great importance to avoid unintended or counterproductive effects. One way to explore the correspondence between symbols as they are sent and received is to examine the accessibility of a priori concept associations for those symbols using response latencies in a primed reaction time task. During a typical priming task, two stimuli occur in succession. The first is the priming stimulus, e.g. a symbol, and the second is a target stimulus to which a response is required, i.e. the effect one wishes to signify - a phrase that is related to the prime. When the prime and the target are related, responses are faster or more accurate than when they are unrelated (Carr, McCauley, Sperber & Parmelee, 1982; Neely, 1991). They are described as more accessible outcomes of the prime. It is assumed that activation of associated concepts occurs automatically and without intention (Fazio, Sanbonmatsu, Powell & Kardez, 1986). These effects of priming reside within dual process models in social psychology which contrasts a relatively slow reflexive processing with a more rapid impulsive response. As such, forced choice responses under time pressure may better measure an impulsive system that is engaged when food is being chosen.

This research used mixed methods to test three symbols in the context of food and health; a heart, a bathroom weighing scale and a running shoe. Since health decisions are driven by the positive and negative consequences of behavior, the first study explored health representations and valence associated with the three images using a brief, qualitative field interview. These three images were chosen so that they could incorporate a facial expression, as this might intuitively communicate information about healthy (positive) and unhealthy

(negative) options to a consumer to promote approach or avoidance behavior respectively. Symbols that promote approach and avoidance may be helpful in biasing choice at the PoP to a healthier alternative.

For the first study, participants responded to an open ended question about what each image 'said to them about health'. It was predicted that the images would be construed consistent with the themes heart health, weight control and fitness. This was an important pre-requisite for study two which examined the accessibility of a priori concept associations stratified by valence, in a computerized response latency task. Study one was important because increased accessibility can only be expected when individuals recognize the symbol and the theme or category the symbol represents.

Study one

Method

Participants and materials

Members of the public (N = 1200) were recruited in Birmingham city centre. The study was approved by the Ethics subcommittee of the School of Sport, Exercise and Rehabilitation Sciences. Three images were used to represent the themes heart health, weight control and fitness; a heart, a bathroom weighing scale and a running shoe. The images were of uniform size, presented in color on a single A4 sheet of paper. Facial expressions were added to three versions of each image yielding four possible variants (no face, smiley face, neutral face and a sad face).

Procedure

In a replicated cohorts design to control for effects of random sampling, four investigators approached two convenience sampled cohorts of 100 individuals to answer a single question about each image variant. Participants were shown one of 12 images and

were asked; “What does this image say to you about health?” Their response was recorded verbatim. Participants’ demographics were coded using standardized criteria for gender (54.4% male), age (10.3% > 60 years), skin color (34.6% non-white) and weight status (15.4% Overweight). Weight status was estimated by comparing the participants size relative to a 7.5 inch high silhouette of a man or a woman with a BMI of 25 (overweight), with greater than the silhouette compared with the same or less.

Data analysis

Participant responses were content analyzed independently by two researchers and coded as to a) whether they related to the intended theme and b) the positive and negative valence of the content. Responses were not limited to a single category. There was missing or incomplete data for nine participants, yielding a final sample size of 1191. Multivariate logistic regressions on the coded categories used image theme, facial expression and the demographics of gender, age, skin color, weight status and cohort as the potential independent variables.

Results

Forty-four percent of responders failed to mention the theme fitness when presented with the image of a running shoe, compared to 41.0% and 33.2% for the themes weight control and heart health respectively. Hence, the running shoe was selected as the comparison variable in the regression analysis as was the no face version of each image. Participants were more likely to link the theme of heart health to its image relative to the running shoe (OR = 1.69, P <.001, 95% CI = 1.26-2.27), with no significant effects of facial expression, demographic group or cohort.

For valence, the heart was more likely to be viewed positively (OR=2.06, P<.001, 95% CI=1.42-2.98) and the scale negatively (OR=0.27, P<.001, 95% CI=0.17-0.41) relative to the running shoe. Perhaps unsurprisingly, the smiling face was seen as more positive (OR=13.13, P<.001, 95% CI= 8.56-20.13) and the sad face less positive (OR=0.24, P<.001, 95% CI=0.14-0.42) than no facial expression. The only effect of demographics concerned age (OR=1.49, P<.001, 95% CI=1.15-1.85), with older people more likely to make a positive evaluation than younger people ($\chi^2(2) = 7.09$, $P < .05$). Concerning negative valence, both the heart (OR=3.24, P<.001, 95% CI=2.16-4.86) and the scale (OR=3.08, P<.001, 95% CI=2.07-4.59) were more likely to elicit negative evaluations relative to the shoe. While the sad face was seen as more negative (OR=18.15, P<.001, 95% CI=11.68-28.19) and the smiling face more positive (OR=0.25, P< .001, 95% CI=.012-0.49) than no face, the face with a neutral mouth was also seen as more negative (OR=2.98, P<.001, 95% CI=1.99-4.57). There were no effects of demographics. Analysis of the comparison items revealed that the running shoe ($\chi^2(1) = 42.31$, $P < .001$) and faceless images ($\chi^2(1) = 12.33$, $P < .001$) were more likely to elicit a positive evaluation than a negative one.

Study two

Response latency was used to explore accessibility of concepts that might be related to the heart and scale as these were the images that best linked to their intended themes. Valence was a key design element given the differences between images in study one. Concepts were chosen to represent negative and positive pairs of a priori cognitions related to the images; Heart disease is a circulatory problem (*raised blood pressure* vs. *good circulation*), exacerbated by poor diet *(saturated fat* vs. *low cholesterol)* and possibly stress *(chest pain* vs. *no stress).* Weight gain which is influenced by food intake (*high calorie* vs. *sugar free, junk food* vs. *balanced diet)* can affect body shape (*big belly* vs. *trim waist*). The phrases, apart from the appearance related ones (*big belly* vs. *trim waist*), are from health

promotion materials. Participants had to decide whether the phrase was associated with the theme conveyed by the image. Consistent with priming effects discussed earlier, it was predicted that heart-related phrases would be more accessible, i.e. have faster response times, when paired with the image of a heart than scales and the opposite pattern for weight-related phrases. Concerning valence, it was predicted that positive and negative phrases would be accessible for the heart image whereas the scale would be more rapidly related to negative phrases, based on the results of the first study.

Participants

Participants were a convenience sample of 20 male and 20 female students (mean age = 20.6 years; mean BMI = 22.6). The majority of individuals (35/40) were of white British ethnicity. Three participants with incomplete data were excluded.

Procedure

In the response latency task participants were required to indicate as quickly as possible the likelihood that the various phrases were linked to the two images from the previous study; the heart and bathroom scale. To avoid biasing responses relative to valence, images without facial expression were used. To control for any possible effects of order, stimulus presentation was determined by a 4 x 4 counterbalanced Latin square for the images (heart/scales, positive/negative valence of phrase) interleaved into a 12 x12 counterbalanced Latin square for the phrases resulting in 144 trials in which each phrase occurred a total of six times with each image and the serial position of stimulus condition was equated across items.

Colored stimuli on a white background were presented with a Viglen Genie computer with a Phillips 109 CRT screen using E-Prime. The sequence of stimulus presentation was a white screen with a central fixation point for 500ms, an image presented in the center of the

screen for 200ms followed by addition of a phrase, written in black, two lines below. Both stimuli remained on the screen until the participant responded by pressing one of two keys (Z or M) on the keyboard which corresponded to linked = likely, not linked = unlikely. Two versions of the program were created to control for effects relating to side of the likely/unlikely keys. Before completing the test, participants were informed of the protocol and signed a consent form.

Data analysis

Median reaction times for the modal response for each paring were computed followed by a reciprocal transformation of response latencies before analysis to reduce the skew. Results are presented as response latencies in ms to facilitate interpretation. To examine if linked phrases were more accessible for their intended theme than the control image, idiographic analyses employed Bonferroni corrected *t*-tests comparing those individuals with the modal the response for links to the intended image and the modal response for the same phrases relationship with the other image.

Results

Table 1 presents the average frequency for the judgments that each phrase would be linked to each image. A repeated measures MANOVA with gender as the between subjects factor and four within subjects factors of image, theme (heart vs. weight), valence (positive vs. negative) and pair (e.g. raised blood pressure vs. good circulation) revealed main effects of image, theme and valence (all p <.005) and a four-way interaction (Wilks's Λ = .701, $F(2,34) = 7.26$, $P = .002$). Paired sample t-tests with Bonferroni correction revealed that participants were more likely to link the phrases *raised blood pressure, good circulation, chest pain, no stress* and *low cholesterol* with the heart and *big belly, trim waist* and *junk food* with the scales (all $p < .008$). There were no differences between the images in the likelihood

of linkage to *saturated fat, high calorie, sugar free* and *balanced diet.* Analyses of valence overall, revealed that the heart was more likely to be linked to positive than negative phrases for both the heart health ($t(36) = 5.15$, $P < .001$) and weight themes ($t(36) = 3.04$, $P = .004$). This effect for the weight theme reflected the fact that the heart was not linked to the negative phrases. For the scales, there were no differential propensities by valence (both $P > .15$).

Insert table 1

For the idiographic analyses of response latency, only individuals with four or more (out of six) likely or unlikely key presses for a phase were included. Further, only comparisons of potential linkage to each image for a particular phrase are possible; reading and comprehension time are confounded with accessibility across phrases. Additionally, the fact that a phrase such as *saturated fat* was generally not seen as linked to either image meant that idiographic analyses could not simply test the likely response to the intended image with the unlikely response to the comparator (c.f. Eves & Hoppé, 2009). For saturated fat, unlikely key presses were more common than likely ones. Table 2 presents average response latencies for modal responses to the judgment that each statement would be linked/not linked to each image. It includes the number employed for the comparison and whether the average is for the likely or unlikely key. After Bonferroni correction, only the heart linked phrases of g*ood circulation* and *raised blood pressure* were more accessible for the heart than the scale.

Insert table 2

Discussion

The results of study one showed that the heart image was best linked to its intended theme of the three images. Concerning valence, the heart could be seen as both positive and negative whereas the scale was less likely to be viewed as positive relative to the shoe. If negative valence can be translated into avoidance, the scale may help bias choice away from undesirable foods. There was a solitary effect of age on positive valence suggesting image

construal was relatively uninfluenced by demographic group. The counter balanced multivariate design allowed a test for effects of the experimental variables, i.e. health and valence, independent of each other and demographic grouping. Further, replicated cohorts designs specifically test effects that only generalize to the population.

As in the first study, the results of study two showed that the heart appeared more useful as a potential prompt. It was linked to five of the six a priori phrases and there was evidence that three of these phrases were more accessible. In addition, the heart was better linked to positive poles than negative ones, suggesting it may be more useful to prompt approach behavior, i.e. healthful choices. It was also better linked to the positive poles of the a priori weight themed phrases than the negative poles, a result that reflected the fact that the heart was not linked to the negative weight theme phrases. The food choice descriptors such as sugar free and high calorie for the weight theme were neither more likely to be linked to the scale, nor more accessible when the decision was made. Saturated fat for heart health was similarly disadvantaged.

The results are consistent with conceptual priming effects. Conceptual priming occurs when related ideas or concepts are used to prime the response. Here, for example, the image of a heart primed the phrases ‘raised blood pressure’, ‘good circulation’ and perhaps ‘no stress’ because they belong to the same conceptual category, i.e. heart health. Conceptual priming involves analysis of stimulus meaning (Vaidya, Gabrieli, Keane, Monti, Humberto & Zarella, 1997). Nonetheless, symbols can be interpreted in different ways by different individuals. There may not be a universal pattern of associations or comprehension. This discrepancy can lead to a mismatch of meaning, i.e. the symbol is interpreted differently from what was intended because it does not conjure up the same patterns of associations in the minds of the consumer and its maker. The running shoe failed to communicate the theme fitness in study one and a-priori concepts were neither linked nor more accessible for the

symbols as we anticipated in study two. This supports the premise that careful study of the correspondence between symbols as they are sent and received is important for effective health communication.

Overall the results suggest that a heart symbol may be useful to remind people about their heart health at the time food is chosen and guide them *towards* a healthier choice. Not only that, it can facilitate rapid decisions (< 800ms) about the healthfulness of food, especially in relation to blood pressure and circulation. Latencies below 800ms are more likely to reflect putative automatic links than deliberative processing (see Eves & Hoppé, 2009; study one). Results from study one suggest that positive and negative valence, i.e. approach or avoidance, may be communicated to consumers more effectively by adding simple facial expressions to the images.

Numerous different symbols have been used by health promoters to influence food choice. As well as the heart and weighing scale symbols tested here, Pick the Tick was used in Australia (Noakes & Crawford, 1991), and green and purple keyholes in Nordic countries (Larsson, Lissner & Wilhelmsen, 1999) and the USA respectively (Lando & Labiner-Wolfe, 2007). Further, the most comprehensible symbol in the studies reported here, the heart, has been used to convey different information by separate interest groups; calories, saturated fat, sodium and fiber. The studies here investigated the meaning, consumers themselves, attach to the symbols in the context of food choice. Additionally, response latency measures tested the ease of the 'decision' making process. The intuitive meaning of symbols to consumers may be more important to their choices than the meaning ascribed to them by health promoters. If a time pressured consumer is to be swayed by a symbol, then a relatively intuitive symbol that cues a more rapid impulsive response would make the decision process more efficient. In contrast, extensive repetition may be required to develop relatively automatic responses to a symbol which is not linked to health by the consumer, e.g. an image

of a running shoe. An intuitive 'belongingness' between the symbols and the information it seeks to convey seems desirable.

Interviews and computerized experiments can lack external validity. One needs to understand the context in which the symbol is communicated in order to comprehend its meaning and act appropriately. It is possible that a priori cognitions would be more accessible in the field. Equally, finger press responses in a computerized task cannot be equated with behavioral enactment. There is evidence, however, that the heart symbol can promote healthy choices in the field (Levin, 1996). Participant responses in the qualitative field interview were content analyzed independently by two researchers, with a simple coding scheme applied to the data. Inevitably, content analysis is subjective. To overcome this problem, responses were only included in each category if both researchers were in agreement.

For the idiographic analyses of response latency, only individuals with four or more (out of six) likely or unlikely key presses for a phrase were included. Inconsistency in response patterns indicates that some participants could not decide if the phrases are linked or not linked to the image. As most of the phrases were from health promotion materials, this inconsistency may accurately reflect individual uncertainties. Nonetheless, inconsistencies in response choice within participants would inflate the error in the median whereas inconsistencies between participants reduced the sample size for any comparison and increased the chance of type II error. For response latency, only analyses for the same phrases across images are possible; different phrases would be associated with different processing times. As a result, conclusions about the relative accessibility of different concepts with respect to any image were precluded. Further, response latency studies of individually elicited concepts would be inextricably confounded by differences in processing time such that a fully idiographic analysis of accessibility would be impossible. Finally, the

use of a student sample in the second study may compromise the external validity of the results. Nonetheless, the heart symbol appeared superior to the bathroom scales in the students as it had with members of the general public in study one.

Conclusion

Symbols can influence the accessibility of cognitions relevant to food choice. However, we often take symbols for granted sometimes mistakenly assuming that they convey exactly what we intended. From this it's easy to see how public health messages may fail because makers use images to signify concepts that do not conjure up the same pattern of associations in the minds of its target group. Results from a qualitative field interview ad a computerized response latency task across two independent samples were triangulated to show that a heart symbol is useful to prompt healthy choices at the PoP. This was evidenced by the meaning participants attached to the symbol and the ease with which a priori phrases about the (un)healthiness of food were identified relative to the other symbols. There was some evidence that the scale may help bias choice away from undesirable foods. This research furthers our understanding of the mechanisms whereby symbols could cue healthy choices at the point of purchase.

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Table 1. Mean number of likely presses (SD) for the judgment that each semantic associate would be linked to each image

Semantic associate pair	**Heart**	**Scales**
1. Raised BP	*4.03 (2.37)***	1.22 (1.46)
2. Saturated fat	*2.00 (1.86)*	2.35 (2.07)
3. Chest pain	*3.62 (2.34)***	1.24 (1.69)
1. Good circulation	*5.11 (1.51)***	2.08 (2.06)
2. Low cholesterol	*4.00 (1.75)***	2.18 (1.90)
3. No Stress	*4.05 (1.84)***	1.43 (1.91)
1. High calorie	2.00 (1.81)	*2.76 (2.18)*
2. Junk food	1.30 (1.90)	*3.51 (2.28)***
3. Big belly	1.46 (1.80)	*3.81 (2.08)***
1. Sugar free	3.43 (2.27)	*2.24 (2.17)*
2. Balanced diet	4.05 (1.96)	*4.89 (1.51)*
3. Trim waist	3.22 (2.26)	*4.76 (1.61)**

Note: Italicized numbers indicate the likely a-priori response. *** $P < .001$, ** $P < .01$

Table 2. Mean response latency in ms (SD) for the judgment of the linkage between each semantic associate and each image.

Semantic associate pair	***N* =**	**Likely/ Unlikely**	**Heart**	**Likely/ Unlikely**	**Scales**	***t* =**	***P* =**
1. Raised BP	21	L	746 (158)	U	870 (180)	3.31	.003
2. Saturated fat	16	U	709 (157)	U	725 (115)	0.27	.79
3. Chest pain	19	L	730 (131)	U	730 (152)	0.07	.94
1. Good circulation	22	L	719 (113)	U	862 (182)	3.59	.002
2. Low cholesterol	10	L	943 (239)	U	1000 (206)	0.81	.44
3. No Stress	20	L	775 (175)	U	917 (192)	2.90	.009
1. High calorie	14	U	775 (197)	U	746 (175)	0.62	.55
2. Junk food	13	U	794 (140)	L	877 (228)	1.27	.23
3. Big belly	18	U	813 (129)	L	813 (188)	0.26	.98
1. Sugar free	13	U	763 (202)	U	685 (167)	1.77	.10
2. Balanced diet	20	L	775 (165)	L	709 (144)	2.35	.03
3. Trim waist	17	L	662 (128)	L	714 (168)	1.48	.16